



**US Army Corps  
of Engineers®**

# CONSTRUCTION BULLETIN

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**CEMP-E / CECW-E**

**Subject:** Contractor's Employee Fatality at a Job Site

**Applicability:** INFORMATION

1. **PURPOSE.** This Construction Bulletin (CB) provides information regarding a recent on-the-job fatal accident. The purpose is to bring to your attention the cause of the accident and to provide information that will assist you and contractors in preventing similar accidents.

2. **BACKGROUND.**

a. The accident occurred on 17 March 1999 and happened when a section of a flat roof under repair gave way beneath a contractor's employee. As a result, the worker fell through the roof onto a concrete floor, causing his death. The roof failure was sudden and unexpected. Prior experiences with work performed on this same roof had been incident free with no reported failures since the construction of the roof in 1955. A Board of Investigation was appointed by the district commander to investigate the cause of the accident.

b. The scope of the repair work was to remove the existing 5 ply built up roof structure and install a new EPDM roofing membrane. The work included: (1) remove loose stone cover, (2) saw through and remove 5 ply roofing felts and 2 inch thick thermal insulation and, (3) remove roofing felt with spudding shovels leaving the exposed surface of the 2 to 2 ½. inch thick gypsum concrete deck. The gypsum is reinforced with #12 gage steel wire at four (4) inch longitudinal spacing (perpendicular to the joists) and #14 gage steel wire at eight (8) inch transverse spacing. The gypsum was placed on ¼ inch thick cement (transite) form boards that also serve as the finished ceiling. The form boards are supported on two sides by steel bar joists. Bar joists spacing varies from two feet, seven inches to two feet, nine inches.

c. On 4 February 1999 the initial work operations started on the roof. A walk through inspection of the building was performed on this day. A broken form board was noted and a sample was collected for asbestos testing. The form board tested positive for asbestos and work on the roof was halted. Since the material between the gypsum deck and the bar joists contained asbestos, anchors bolts (toggle bolts) could not be used (as an anchorage method) because drilling through the asbestos cement form board is not acceptable. Instant stick adhesive was proposed and accepted as an alternate anchorage method.

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d. The contractor resumed work on the building on 17 March 1999. Approximately, fourteen (14) contractor employees were on the roof to saw through and remove the built up roofing, remove the thermal insulation, and spud off the felt above the gypsum concrete structural deck. The safety measures in place addressed potential falls from the roof, not falls through the roof. On this day, the deceased was performing the last phase of roof removal, spudding off the felt from an area above the equipment room. That is when a section of the roof gave way beneath him.

### 3. BOARD OF INVESTIGATION REPORT FINDINGS.

a. A walk through inspection of the building after the accident revealed a number of areas where the transite form board ceiling was missing and the gypsum deck exposed. The report concluded that the ceiling and roof damage most probably occurred after the 4 February 1999 inspection as a result of the ongoing construction activities.

b. The Board's opinion is that the failure of the gypsum concrete deck was due to the deterioration of the reinforcing wires in the gypsum concrete at the location of the failure. Reinforcing wire in the area of failure was heavily rusted. Some ends of the broken reinforcing wire showed "necking," characteristic of metal yield immediately before failure. Other wires were either broken in shear or were apparently completely corroded. Based upon the calculations provided in the report, once the wire has corroded past 75 percent of the diameter, the roof deck is unsafe for normal working loads involving people and equipment similar to the ongoing operations.

c. The Board also reported that the load carrying capacity of the roof deck is estimated based upon an assumption that the load is applied over two foot wide section. The 5 ply roofing and thermal insulation can act to distribute the load over the substance structural deck (gypsum deck in this case), thereby increasing the load carrying capacity of the roofing system for localized loads. Removal of the 5-ply roofing and insulation allows concentrated loads to be applied directly to the gypsum deck, reducing the effective area of the deck resisting the load. The report indicated that imposed roof loads were not abnormal for this operation. Weather conditions were not abnormal and did not contribute to the roof failure.

d. From onsite interviews, it was reported that during construction operations, "soft spots" were noted in areas of the roof, but apparently not reported to the site supervisor. No specific investigation was made to determine the nature of the soft spots.

4. RECOMMENDATIONS. Until further instructions are issued by the Safety and Occupational Health office and until updates to EM 385-1-1 are made, the following recommendations should be implemented as a minimum. The recommended actions under paragraph a. below should take place during the design phase when feasible:

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a. Roofs of less than 15 degrees slope that have not been properly maintained and which show signs of aging deterioration should be examined by a structural engineer. The structural engineer should review all available as-built details. A structural survey should be performed to determine how safe it is to work on the roof. When appropriate this should include testing (coring) the lightweight concrete for structural soundness, especially in deteriorated areas. The transite form boards should be tested for asbestos in order to avoid possible health hazards and delays during construction. According to the survey and test results, the necessary engineering measures and safety precautions should be taken during the repair work. Construction Representatives must assure that these tests and precautionary measures are taken prior to the start of the repair work.

b. During the repair work, the structural engineer should regularly examine the roof condition to determine if any additional precautionary measures are needed.

c. Contractor's workers should be required to report to the site supervisor any observations on the condition of the building such as "soft spots" on a roof, damaged areas, etc. that occur during construction activities. All the reported structural conditions that may affect the structural soundness of the roof should be investigated and reported to the structural engineer.

5. This CB was coordinated with the following HQUSACE organizations: Office of the Chief Counsel (CECC-C); and, Safety and Occupational Health Office (CESO-ZA).



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